

What is claimed is:

- 1 1. A method for analyzing a sample of wafers, comprising the steps of:
  - 2 (a) identifying F failure metrics that are applicable to at least one circuit pattern on each  
3 wafer within the sample of wafers, where F is an integer;
  - 4 (b) identifying Z spatial and/or reticle zones on each wafer, where Z is an integer;
  - 5 (c) providing values for each of the F failure metrics, for each of the Z zones on each  
6 wafer;
  - 7 (d) defining a point for each respective wafer in an N-dimensional space, where  $N=F*Z$ ,  
8 and each point has coordinates corresponding to values of the F failure metrics in each of the  
9 Z zones of the corresponding wafer; and
  - 10 (e) clustering the sample of wafers into a plurality of clusters of wafers, so that the wafers  
11 within each cluster are close to each other in the N-dimensional space, thereby identifying the  
12 plurality of clusters of wafers from the sample of wafers so that within each individual  
13 cluster, the wafers have a similar distribution of defects.
- 1 2. The method of claim 1, wherein step (c) includes extracting the values from failure bit  
2 map data, multi-probe data or final die sort data collected from each wafer, using a die sort  
3 tester.
- 1 3. The method of claim 1, wherein:
  - 2 step (b) includes identifying Z reticle zones, corresponding to Z zones within a reticle  
3 used to make each wafer,
  - 4 each wafer has E reticle fields corresponding to E exposures of the wafer using the  
5 reticle, and
  - 6 step (c) includes providing, for each wafer, Z values for each failure metric, each of  
7 the Z values representing a combined measure of the values of that failure metric for a given  
8 one of the reticle zones across all E reticle fields of that wafer.
- 1 4. The method of claim 3, wherein the D reticle zones correspond to D die within each  
2 reticle field.
- 1 5. The method of claim 1, wherein:

2 S spatial zones and R reticle zones are identified on each wafer, where R and S are  
3 integers,  
4 steps (c), (d) and (e) are performed with  $Z=S$ , using spatial data from the S spatial  
5 zones, and  
6 steps (c), (d) and (e) are performed with  $Z=R$ , using reticle data from the R reticle  
7 zones.

1 6. The method of claim 1, further comprising after step (d), filtering the data to eliminate  
2 noise.

1 7. The method of claim 1, further comprising after step (d),  
2 performing a principle component analysis on the coordinates for each point to  
3 identify a set of principle component scores;  
4 identifying insignificant principal component scores; and  
5 eliminating the insignificant principal component scores before step (e).

1 8. The method of claim 7, wherein step (e) includes:  
2 initially assigning each wafer to a respectively different cluster;  
3 determining a respective distance between each pair of the clusters in a principle  
4 component space; and  
5 recursively combining into a single cluster the pair of clusters that are separated by a  
6 smallest distance in the principle component space.

1 9. The method of claim 7, wherein step (e) includes agglomerative hierarchical  
2 clustering.

1 10. The method of claim 9, wherein a distance between a given two of the clusters is  
2 defined as the greatest distance, in the N-dimensional space, between any two wafers in the  
3 given two clusters, and the agglomerative hierarchical clustering includes combining wafers  
4 of the clusters until the smallest distance between any two of the clusters exceeds a  
5 predetermined threshold.

1 11. The method of claim 8, wherein the distance between a pair of clusters is defined as  
2 the greatest distance between any two points corresponding to any of the wafers in the pair of  
3 clusters.

1 12. The method of claim 1, wherein step (e) comprises:  
2 (e1) initially assigning a subset of the wafers to one of the clusters;  
3 (e2) determining a respective distance between the point corresponding to each of the  
4 subset of wafers and a centroid of the one cluster;  
5 (e3) calculating a first sum of the squared errors from the distances of step (e2);  
6 (e4) calculating a second sum of the squared errors that is obtained from each of two  
7 partitioned clusters to be formed by partitioning the one cluster, where the second sum of the  
8 squared errors is based on the respective distance between each point and a centroid of the  
9 respective partitioned cluster to which that point is to be assigned;  
10 (e5) partitioning the one cluster into the two partitioned clusters, if the second sum of the  
11 squared errors is significantly less than the first sum of the squared errors.

1 13. The method of claim 12, wherein step (e5) comprises partitioning the one cluster into  
2 the two partitioned clusters, if one minus a ratio of the second sum of the squared errors  
3 divided by the first sum of the squared errors exceeds a threshold value.

1 14. The method of claim 1, further comprising performing a commonality analysis to  
2 identify one or more pieces of equipment responsible for a lot of wafers having a yield below  
3 a desired yield.

1 15. The method of claim 14, wherein the commonality analysis includes a Monte Carlo  
2 simulation.

1 16. The method of claim 14, wherein the commonality analysis includes analysis of  
2 variance between lots of wafers.

**AMENDED CLAIMS**

[received by the International Bureau on 04 August 2004 (04.08.04);  
claim 1 amended]

- 1 1. A method for analyzing a sample of wafers, comprising the steps of:
  - 2 (a) identifying F failure metrics that are applicable to at least one circuit pattern on each
  - 3 wafer within the sample of wafers, where F is an integer;
  - 4 (b) identifying Z spatial and/or reticle zones on each wafer, where Z is an integer;
  - 5 (c) providing values for each of the F failure metrics, for each of the Z zones on each
  - 6 wafer;
  - 7 (d) defining a point for each respective wafer in an N-dimensional space, where  $N=F*Z$ ,
  - 8 and each point has coordinates corresponding to values of the F failure metrics in each of the
  - 9 Z zones of the corresponding wafer; and
  - 10 (e) clustering the sample of wafers into a plurality of clusters of wafers using a computer,
  - 11 so that the wafers within each cluster are close to each other in the N-dimensional space,
  - 12 thereby identifying the plurality of clusters of wafers from the sample of wafers so that within
  - 13 each individual cluster, the wafers have a similar distribution of defects.
- 1 2. The method of claim 1, wherein step (c) includes extracting the values from failure bit
- 2 map data, multi-probe data or final die sort data collected from each wafer, using a die sort
- 3 tester.
- 1 3. The method of claim 1, wherein:
  - 2 step (b) includes identifying Z reticle zones, corresponding to Z zones within a reticle
  - 3 used to make each wafer,
  - 4 each wafer has E reticle fields corresponding to E exposures of the wafer using the
  - 5 reticle, and
  - 6 step (c) includes providing, for each wafer, Z values for each failure metric, each of
  - 7 the Z values representing a combined measure of the values of that failure metric for a given
  - 8 one of the reticle zones across all E reticle fields of that wafer.
- 1 4. The method of claim 3, wherein the D reticle zones correspond to D die within each
- 2 reticle field.
- 1 5. The method of claim 1, wherein: